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ABSTRACT

Created to help teachers develop, evaluate, and use computer-assisted instruction (CAI), this guide is intended for "first-time" CAI authors who do not program. (As used here, an author is the teacher who designs and develops objectives and content and creates learning strategies for CAI.) Content of the guide is organized into the five stages in the production of CAI software or coursework. Discussion of state 1 considers development of the authoring design, a generally written plan for the CAI lesson; development of specific learning ob)ectives; writing of content or information to be included in the lesson; and joint author-programmer planning. The largest section focuses on the second stage, the selection of the learning strategies that can best be used to confront students with a given content of knowledge. These strategies are discussed: dialogue, drill and practice, problem solving, and simulation. Samples are provided. In the next three sections, suggestions and guidelines are offered for stage 3, programming; stage 4, evaluation; and stage 5, use and distribution. Appendixes include a glossary, a sample system of evaluation, a sample abstract of a CAI lesson, a sample user's guide for a CAI lesson, and a bibliography. (YLB)

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A GUIDE FOR AUTHORING AND PROGRAMMING COMPUTER-ASSISTED INSTRUCTION

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A GUIDE FOR AUTHORING AND PROGRAMMING COMPUTER-ASSISTED INSTRUCTION

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INTRODUCTION

The purpose of this guide is to help teachers develop, evaluate, and use COMPUTER-ASSISTED INSTRUCTION (CAI). The guide is intended for "first-time" CAI authors* who do not program.* Special assistance was provided by the Oregon State Department of Education through a Computer-Assisted Instruction Project Grant for Nursing Students, 1981-1982, for authoring and programming CAI and for creating this guide. The input to this publication includes recommendations from faculty involved with CAI in a number of teaching disciplines at Chemeketa Community College in Salem, Oregon.

CAI is a mode of teaching in which information is programmed for presentation on the computer screen*. The user chooses the content he/she wishes to learn by using the computer keyboard in response to instructions on the television-like screen . . . thus interacting with the computer. A positive, personalized, and highly individualized learning experience is thereby possible. The programmed material, stored on disks, is called software* or courseware*.

An important CAI goal is the provision of unique learning experiences which will not duplicate other customary kinds of learning. Even though CAI has been employed for some years, uniqueness is still difficult to achieve, especially for "first-time" authors and programmers. The unique quality becomes more likely as instructors and programmers are more sophisticated in the use of computers and languages for learning, and as hardware* capabilities and new program languages help to increase the potential for creativity.

*Throughout this guide, please see the Glossary for definition whenever one asterisk is used.

The instructor who wants to begin to author CAI can improve his/her chances for producing high-quality material by taking some of these preliminary steps:

- Educate yourself about CAI through reading, meetings and observations, especially in your own teaching field.
- Search for completed CAI courseware in your own field for review. Note particularly the learning strategies used and capabilities of languages and computers in facilitating learning.
- Secure administrative support for CAI in your educational institution. Be certain you have the needed hardware, software, and programmers. CAI production takes much time; released time or other arrangements are advisable to make that time available.
- While you are learning about CAI, also explore the general uses of computers in your field. For instance, if you teach nursing, find out about computerized health information systems in the health field. You may also want to help students learn more about computer applications in your field.
- Learn about the computer and computer languages, especially the kinds that you will be using (for instance, Apple II Microcomputer and PILOT, BASIC, or PASCAL languages).
- If computers are new to you, don't let ignorance or awe stand in your way. If you are interested in helping students use a variety of learning strategies, CAI can be a rewarding learning experience for you. CAI is simply another medium, like video, for helping students to learn.
- Find a consultant for CAI, in your own field especially. Use him/her to the fullest.
- Decide whether you wish both to author and program the lesson you choose or whether you will only author the lesson and work with someone else who will program. Many teachers would be unable to develop CAI without the help of programmers, since they may not have programming skills. This guide is for instructors who will author only.
- Evaluate CAI as you progress. Does it help to improve student learning? Are the results worth the time spent? Are your strategies effective? Evaluation can be described as a kind of Computer-Managed Instruction (CMI*).

STAGE 1. AUTHORING DESIGN, OBJECTIVES, CONTENT, AND AUTHOR-PROGRAMMER PLANNING

The Authoring Design is the instructor's general written plan for the CAI lesson. It is an excellent medium for identifying goals and subject matter. The design can include:

subject title
instructional goals
description of the course in which the CAI lesson will be used
description of the students who will use the lesson
other instructional media used
student reading comprehension levels
computer and language to be used
evaluation plans.

Anything can be included which helps the instructor to set goals and establish an instructional rationale.

After you have some fundamental understanding of CAI, as described on page 3, then begin the design process by identifying the subject of the CAI lesson you want to develop. The choice of subject matter is dependent upon the author's interests and discipline, the needs and characteristics of the students taught, the capabilities of the language and computer used, and the ability of the author and programmer to construct an effective CAI lesson.

Next, consider the general instructional goals for the lesson. For instance, CAI should provide:

- a unique learning experience,
- individualized learning through frequent interaction with the computer,
- a method for improving student achievement in the subject,

- clear, current, and complete content,
- simplified and useful learning with uncomplicated vocabulary and concrete examples,
- content appropriate to the learner's knowledge level,
- a tutorial* approach which is within the learner's comprehension level,
- a positive, personalized, enjoyable learning experience,
- a multimedia approach, if appropriate,
- a simple overview of content and instructions for user involvement at the onset,
- classroom follow-up,
- varied learning techniques,
- individualized response to the user's answers,
- an approach which minimizes user anxiety,
- avoidance of lengthy textual passages, and
- a system for evaluating the lesson.

Now go on to complete the design, describing the plan for your courseware as identified in the first paragraph, page 4. Include any other information which will help to clarify your ideas. The design should provide a very useful framework for you as you continue to develop your courseware.

Objectives: Develop specific learning objectives for your lesson. What will a user understand or be able to identify after taking the lesson? You may need to modify the objectives frequently during CAI development, as you explore what is most important for student learning and what is possible through CAI.

Content: In concise format, write the basic content or information you want included in the lesson; include any graphs or other materials you plan to use. This is an extension of the objectives. If you know what you want to present in the way of content and have this organized on paper, the next stage of developing learning strategies is greatly simplified; learning strategies are the instructional methods used to present the content. The content may involve several or more pages of material spelling out the information you hope the user will learn. You may want to make changes in the content as you proceed with the lesson and identify improvements.

Author-Programmer Planning: The following describes how authors and programmers work together to produce CAI. The author-programmer relationship is a challenge, especially since each will need to learn about the discipline of the other, in order to communicate and produce effective results.

As well, the contributions of others can professionalize the CAI production. For instance, a graphic artist can help to improve the quality of the display. A video specialist and an education expert can assist in their areas of expertise. Content specialists can help by evaluating the accuracy of the information presented. Students can provide very useful ideas throughout the courseware development and when evaluating the completed lesson.

The author, programmer, and any other appropriate contributors begin planning together at the onset of CAI development. Joint planning involves early brainstorming about the lesson and learning strategies. As this is occurring,

the author should also be writing the lesson design, objectives, and content and should then share these with the programmer.

The author should be the expert on lesson content and should be clear about what he/she hopes to accomplish and what the student should be able to learn in the CAI lesson. The programmer should be the computer, language, and programming expert. It is helpful also if the programmer is interested in learning and teaching and if author and programmer have had previous CAI experience, though this latter experience is not absolutely essential. The author should have some knowledge of the computer, a computer language, and programming.

After completing the design, objectives, and content, the author begins to develop the script of learning strategies; that is, he/she develops a system of writing out what is to be displayed on the screen and includes recommendations for the programmer. See page 10 for an example of a script. This creative process is enhanced when the author assumes full responsibility for the scripting, of learning strategies, and when the programmer is as well fully responsible for programming. This does not mean that the programmer cannot contribute to script development or the author to the programming process; such collaboration can also improve the final product. However, it is beneficial to be clear about where responsibilities lie.

When the script of learning strategies is complete, in part or totally, the programmer and author need to meet more frequently to review the script and modify the presentations. Some strategies may need to be discarded; for instance, when learning is not enhanced or when a better computer application can be used. New strategies may emerge as author and programmer discuss the

issues. When the author and programmer determine that a learning strategy is acceptable, then programming can begin.

When programming of a lesson part has been accomplished, then the author and programmer need to review it to see if any changes are needed. This process is ongoing from this point on and at times may seem unending.

Finally, the author and programmer have reached a point where the CAI lesson format is satisfactory to both. At this point, the lesson is nearing completion. All of this requires many hours of programming, reviewing the computer lesson, discussing together what should be done, and making modifications until both are satisfied. User evaluation of the learning experience will also provide excellent input for later lesson changes, after the lesson has been completed, used, and evaluated.

STAGE 2. LEARNING STRATEGIES

The next stage and perhaps greatest challenge to CAI authors is the selection of the learning strategies which can best be used to confront students with a given content of knowledge. Learning strategies are the instructional methods used to present the content so that students learn most effectively. The content is presented by means of the strategies, and the content extends from the design and objectives. CAI learning strategies are currently poorly defined. It is essential that learning strategies be more clearly conceptualized and described in the future.

The learning strategies and the programming will determine whether the CAI provides unique, individualized, interactive, and positive learning experiences . . . which is what CAI is all about. The author should decide what

learning strategies can best be incorporated in a lesson. However, the author and programmer must discuss the possibilities from the framework of their own competencies, in order to maximize both educational and computer capabilities.

We see the overall CAI instructional mode as being tutorial in nature, whereby students learn and teachers instruct with use of computer technology. Varying terms have been used to identify the specific learning strategies under the umbrella CAI tutorial mode. The following few strategies have seemed most applicable in our CAI development, though we know that many more are possible:

Dialogue,
Problem-solving,
Drill and practice, and
Simulation.

Dialogue is the conversation-like exchange between teacher and student during the courseware presentation, with learning as the objective. At the very heart of the CAI experience is the one-to-one communication of the author with the student through the computer medium. Users can be addressed in a personal style, employing the user's name. The overall approach can be warm, friendly, helpful, and anxiety-reducing; most first-time computer users are anxious. A common example involves questions posed to the student with requests for response. Information-giving exposition can also be incorporated into the dialogue, although lengthy textual passages should be avoided when possible; they duplicate learning through reading and lock students into a linear* rather than a branching* sequence.

Following is an example of CAI dialogue as it appears in a script.

SCRIPT: DIALOGUE

Stressors, Part 3

Let's examine some specific stressors which bombard the Re-Entry Nurse. Which of the following statements are concerned with Re-Entry stressors? Type y for YES or n for NO after each statement.

Unfamiliar equipment, new methods of treatment, and unknown medications make your head swim!

Programmer: When the user's answer is YES, the computer response should be . . . For the most part this is true. Your reaction will depend on how long you have been away from nursing. Gradually this will be less of a problem. But, you know, name, even experienced nurses feel this way when new equipment, treatments, and meds come along.

Return

Programmer: When user answers NO . . . . . Actually, this is very much a stressor. If your head doesn't swim a little with new equipment, treatments, and meds, maybe you should ask yourself why.

Return

Here is the same previous passage about stressors as it was programmed or coded in the PILOT computer language.

PROGRAMMING - DIALOGUE

```
t:   Let's examine some specific stres-
t:
t:sors which bombard the Re-Entry
t:
t:nurse.  Which of the following
t:
t:statements are concerned with
t:
t:re-entry stressors?
t:
t:Type $c2$ y$c3$  for YES or $c2$
:n$c3$  for NO afte:
t:
t:each statement.
th:$p3$
as:
g:Y
```

```
t:$c$    Unfamiliar equipment,
t:       new methods of treatment,
t:          and unknown medications
t:              make your head swim!
t:
as:
m:y
ty:es
ty:   For the most part, this is true.
:Your reaction will depend on how long you have
:been away from nursing. Gradually this
:will be less of a problem.
wy:5
ty:   But you know, $n$ , even
:experienced nurses feel this way when
:new equipment, treatments, and meds
:come along.
wy:5
jy:Ωp
m:n
ty:o
ty:
ty:   Actually, this is very much a
:stressor. If your head doesn't swim a
:little with new equipment, treatments,
:and meds, maybe you should ask
:yourself why.
ty:
ty:
thn:please answer yes or no...
jn:Ωa
pr:
th:                          return
as:
```

The actual screen displays about stressors will appear in this way.

DISPLAY: DIALOGUE

Let's examine some specific stressors which bombard the Re-entry Nurse. Which of the following statements are concerned with Re-entry stressors? Type y for YES or n for NO after each statement.

RETURN

Type y for YES or n for NO

Unfamiliar equipment,
new methods of treatment,
and unknown medications
make your head swim!

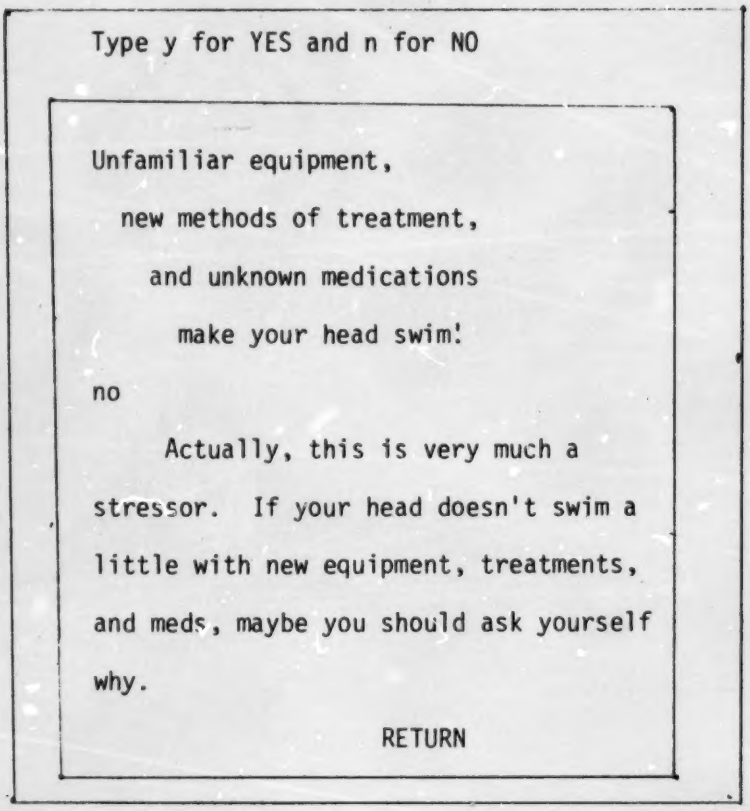
yes

For the most part, this is true. Your reaction will depend on how long you have been away from nursing. Gradually this will be less of a problem.

But you know, name, even experienced nurses feel this way when new equipment, treatments, and meds come along.

RETURN

DISPLAY: DIALOGUE


Type y for YES and n for NO
Unfamiliar equipment,
new methods of treatment,
and unknown medications
make your head swim!
no
Actually, this is very much a stressor. If your head doesn't swim a little with new equipment, treatments, and meds, maybe you should ask yourself why.
RETURN

Drill and Practice is the strategy whereby a student practices and repeats a technique at the computer keyboard in a way which will yield improved skills. For instance, a lesson might present multiplication problems allowing the student to practice as many problems as he/she needs until the problem is mastered. The following script, programming, and display depict CAI drill and practice.

SCRIPT: DRILL AND PRACTICE

Metric, Sub-Menu Weight

Problem 1:

How many mg. are there in .03 Gm?

On Hold: ( )

Programmer: Leave space for learner calculations with computer feedback.

A accept answer ? instructions

C conversion table

Programmer:

On Hold: allows user to work part of problem and retain partial answer or to recalculate and check answer before pushing A to accept answer. Each time a calculation is done, it replaces the previous value in Hold.

Special Keys:

A = must be typed for computer to recognize this answer as user's final answer.

C = displays a chart of all conversions for that

? = displays instructions for the math characters: + = add, - = subtract, * = multiply, / = divide.

PROGRAMING: DRILL AND PRACTICE

```
*quest
t:$c$ Problem #c1
t:
t:How many $r1$ are there in #m $r2$?
t:
t:
t:
```

VARIABLES ARE USED SO RANDOM PROBLEMS CAN BE GENERATED.

```
*back
g:v0,39,7,18

*tag
th:$c$
t:              On Hold :(#x )
t:
t:
j(f3=1):sample
*tag2
a:$a$
m:?
jy:help
m:c
jy:conv
m:a
cy:c2=c2+1
jy:ok
```

BRANCH TO HELP SCREEN

BRANCH TO CONVERSION TABLE

```
*table
t: Abbr.                        # of
:Grams
t:
t:   kg      KILOgram              1000
t:   hg      HECTOgram              100
t:  dkg      DECAgram                10
t:   gm      $c2$ GRAM$c3$
:     1
t:   dg      DECIgram                   .1
t:   cg      CENTIgram                  .01
t:   mg      MILLIgram
:.001
t:  mcg      MICROgram
:.000001
```

```
*help
c:f1=1
g:v0,39,7,23
t:$c$ ************************************
:******
t:
t:$c2$ 1$c3$ . When calculating, use
:$c2$ ONLY$c3$  numbers,
t:
t:   the decimal point, & these
:symbols:
t:
t:        * multiplication
t:        / division
t:        + addition
t:        - subtraction
t:
t:
th:There's more. <RETURN>
```

DISPLAY: DRILL AND PRACTICE

```
Problem 1:
How many mg. are there in .03 Gm?
    On Hold:  (          )

 A  accept answer        ?  instructions
 C  conversion table
```

Problem Solving is the presentation of a problem with the expectation that the student will seek the solution, using a known rationale. For example, a student might be asked to solve a physics or mathematical problem which could involve a series of steps, and the computer would analyze student responses and give appropriate feedback.

Simulation is a reenactment of real-world phenomena so that students learn an action in a highly structured pseudo-situation apart from the real-world activity. For instance, earth-bound simulators are used to train astronauts; science experiments can be simulated through computer display; and medical, dental, and nursing schools use CAI simulated clinical encounters.

CAI simulation can be a highly effective learning strategy because of the very reality and usefulness it conjures up. In a vivid manner, a medical student at the computer keyboard can learn how to provide care to an accident victim through simulated assessment, diagnosis, and provision of care. Or a nurse who has not practiced nursing in many years can experience a simulated interaction with a patient in which she learns to administer a morphine injection appropriately.

A CAI author may want to ask these questions as he/she begins to identify learning strategies:

WHAT KIND OF LEARNING STRATEGIES WILL BEST PRESENT THE CONTENT?

CAN YOU USE DIALOGUE, PROBLEM-SOLVING, DRILL AND PRACTICE, AND SIMULATION?

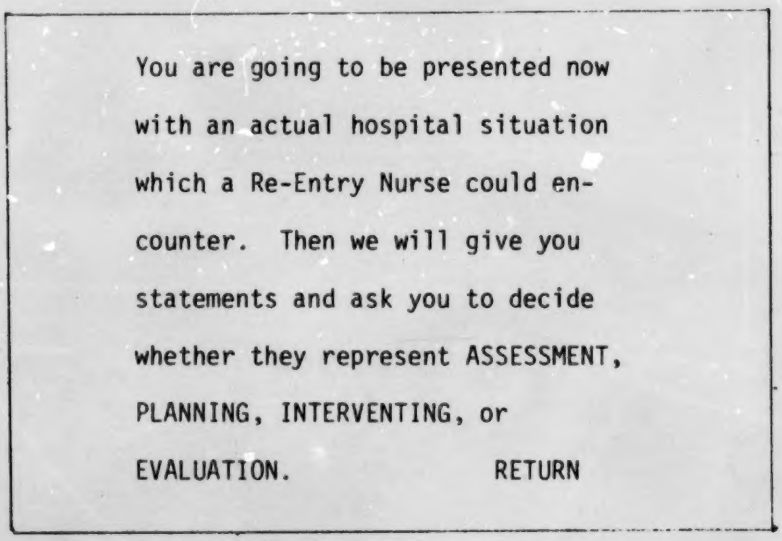
WHAT OTHER LEARNING STRATEGIES CAN YOU IDENTIFY AND USE . . . FOR INSTANCE, GAMING, DATA RETRIEVAL, OR MODELING INTERPERSONAL COMMUNICATION?

CAN YOU BE PATIENT WITH YOURSELF IF SOME OF YOUR EARLY ATTEMPTS AT LEARNING STRATEGIES MAY BE SOMEWHAT IMPERFECT? YOU WILL IMPROVE WITH MORE EXPERIENCE.

CAN YOU CONCEPTUALIZE CAI LEARNING STRATEGIES MORE CLEARLY AND SHARE YOUR FINDINGS?

Now, we present displays as seen on the computer screen from a Lesson On Stress. Please note that both problem-solving and simulation strategies are employed in this presentation.

DISPLAY: PROBLEM-SOLVING AND SIMULATION


You are going to be presented now with an actual hospital situation which a Re-Entry Nurse could encounter. Then we will give you statements and ask you to decide whether they represent ASSESSMENT, PLANNING, INTERVENTING, or EVALUATION.
RETURN

DISPLAY: PROBLEM-SOLVING AND SIMULATION

The head nurse asks you to give morphine stat to Mr. Jones, who is in pain. Your heart leaps and races quickly; your skin blanches while your mouth becomes incredibly dry, and your hands start to shake. You haven't administered morphine in ten years, and your class on narcotics is next week.

RETURN

DISPLAY: PROBLEM-SOLVING, AND SIMULATION

You know nothing about Mr. Jones' condition. The head nurse notices your reaction and tells you about Mr. Jones' health problems and why he needs morphine. You quickly check the doctor's orders, nursing care plan, and nursing notes. Then you review the description of morphine in a pharmacology guide.

RETURN

You prepare the medication and ask the head nurse to check it for you; she also reviews the charting. By the time you approach Mr. Jones, you are calmer, but your hands are still shaking. Mr. Jones notices your shaky hands and looks worried.

RETURN

With effort you calm yourself and appear more confident. Mr. Jones relaxes, and you give the medication effectively.

WHEW!

RETURN

DISPLAY: PROBLEM-SOLVING AND SIMULATION

After each statement please type the number of the Strategy Step which corresponds with the statement.

RETURN

Stress Strategy

Step 1: ASSESS

Step 2: PLAN

Step 3: INTERVENE

Step 4: EVALUATE

What's bothering me is that I don't know the patient and need to find out more about morphine.

When User Presses "1":

1 Excellent. Step 1 is correct. She has ASSESSED her stressors.

RETURN

When User Presses "2","3", or "4":

2 In this statement the nurse was ASSESSING her stressors or causes of her stress, so "1" is the correct answer. RETURN

When User Presses "n":

n Oops! Please type 1, 2, 3, or 4.

RETURN

PROGRAMMING: PROBLEM-SOLVING AND SIMULATION

```
PRINT OF LESSON WRITE


t:$c$ You are going to be presented now
t:
t:with an actual hospital situation
:which
t:
t:a Re-Entry Nurse could encounter.
:Then
t:
t:we will give you statements and ask
:you
t:
t:to decide whether they represent
t:
t:ASSESSMENT, PLANNING, INTERVENTION,
:or
t:
t:EVALUATION.
th:$p3$
as:
```

PRINT OF LESSON PRINT

```
r:****************************************
r:
r:      MODULE NAME: COPE2
r:
r:      CALLING MODULE: COPE6
r:
r:****************************************

*story
g:v
th:$c$
g:m0,0;d552,0;d552,470;d0,470;d0,0
g:v1,38,3,22
t:    The headnurse asks you to give
t:
t:morphine stat to Mr. Jones who is in
t:
t:pain. Your heart leaps and races
t:
t:quickly; your skin blanches while
t:
t:your mouth becomes incredibly dry and
t:
t:your hands start to shake. You
t:
t:haven't administered morphine in 10
t:
t:years and your class on narcotics is
t:
t:not until next week!
t:
th:$p3$
as:

t:$c$    You know nothing about Mr.
:Jones'
t:
t:condition. The headnurse notices your
t:
t:reaction and tells you about Mr.
t:
t:Jones' health problems and why he
t:
t:needs morphine. You quickly check the
t:
t:doctor's orders, nursing care plan,
t:
t:and nursing notes. Then you review
t:
t:the description of morphine in a
t:
t:pharmacology guide.
t:
th:$p3$
as:
t:$c$ You prepare the medication and
:ask
```

```
t:
t:the headnurse to check it for you;
:she
t:
t:also reviews the charting. By the
:time
t:
t:you approach Mr. Jones, you are
t:
t:calmer, but your hands are still
t:
t:shaking.  Mr. Jones notices your
t:
t:shaky hands and looks worried.
th:$p3$
as:
t:$c$ With effort you calm yourself and
t:
t:appear more confident.  Mr. Jones
t:
t:relaxes, and you give the medication
t:
t:effectively.
t:
t:WHEW!!
th:$p3$
as:
g:v


#tst
t:$c$ STRESS STRATEGY
t:
t:  Step 1. ASSESS
t:       Step 2. PLAN
t:            Step 3. INTERVENE
t:                 Step 4. EVALUATE
w:3
t:
t:
t:
t:After each statement please type the
t:
t:number of the STRATEGY STEP which
t:
t:corresponds with the statement.
w:5
c:p1$=p$!!chr(39)!!chr(34)
t:$p1$ $c2$ 1.$c3$
t:       Step $c2$ 2.$c3$
t:            Step $c2$ 3.$c3$
t:                 Step $c2$ 4.$c3$
w:2
c:p1$=p$!!chr(32)!!chr(53)
th:$p1$ <RETURN>
as:
g:v0,39,7,22
t:$c$

#t4
t:$c$  "What's bothering me is that I
:don't know the patient and need to
:find out
t:          more about morphine."
t:
```

```
as:
m:1!step 1!one!step one
ty:   Excellent.Step 1 is correct. She                    25
:has assessed her stressors.
ty:
jy:@p
un:uhoh
t:    In this statement the nurse was
:ASSESSING her stressors or causes of
:her stress, so "1" is the correct
:answer.
pr:
th:$p3$
as:


*uhoh
m:1!2!3!4
tn: Oops! Please type $c2$ 1,2,3,$c3$
:or $c2$ 4$c3$ $u$
wn:3
thn:$c1$
en:@a
e:
```

STAGE 3. PROGRAMMING

Programming is the task of designing an algorithm or step-by-step procedure for solving a problem. This solution is represented in a programming language. The purpose of the programming language is to allow the programmer to communicate with the computer. Unfortunately, computers only understand instructions which are quite obscure to most people. Through computer languages, the programmer can write programs which resemble English. An example would be:

```
REPEAT
    FINDWORD;
    COUNTLETTER;
    COUNTCONSONANTS;
UNTIL FINISHED;
```

This excerpt is from the PASCAL language. The computer will translate this type of programming language, referred to as a high-level language, to machine language or low-level language which in turn can be run on the computer.

Similar to an engineer or architect, the programmer must design an overview of the programming problem and then through a process called step-wise refinement break down the larger programming problem into more manageable pieces. This top-down approach allows the programmer not to lose sight of the overall goal of the program.

A skilled CAI programmer must have good communication skills. The programmer works extensively with the author of the instructional material, and together they go through a repetitive process of revising the material until both are satisfied.

The selection of the programming language used depends on the nature of the lesson. Here is a brief summary of some commonly available languages:

PILOT - Considered to be an authoring language. Easy to learn; well suited for the author who intends to write his/her own material. Not ideally suited for extensive calculations. Graphics somewhat limited.

PASCAL - A well structured language which almost forces the programmer to write clear programs. Very few limitations. Requires a higher degree of skill.

BASIC - One of the most widely used languages in CAI. Lack of program structure can produce quite unmanageable programs which are difficult to maintain.

Some guidelines:

- The programmer should build a strategy file. This can be useful in that actual examples of lesson material strategies are available.
- Programming time can be reduced by developing a computer library of common programming routines. An example would be standardized input/output routines.
- Try to borrow ideas and/or modify them; avoid reinventing the wheel.
- Design layout sheets which minimize the effort of translating the script to a programming language. See the Apple Pilot Coding Sheet in the Appendix, page 40.
- Consider transferability of your program to other environments. This avoids the time-consuming task of reprogramming when changing brands of computers.
- The programmer must design a logical structure that supports student control over the parts of the lesson he/she may want to view. The ability to repeat and/or review information should be built into the lesson.

An example of a student control mechanism is the menu-driven approach. The following display is a menu that might begin a lesson:

CHOOSE ONE OF THE FOLLOWING TOPICS:

1. METRIC LENGTH

2. METRIC WEIGHT

3. METRIC VOLUME

4. END LESSON

ENTER NUMBER OF CHOICE ____

- Be careful how you handle blanks and upper/lower case. If a correct response is "yes" then "Yes" should also be accepted.

    EXAMPLE IN PILOT:

```
PR:L                (converts all user input to lower case)
A:                  (accepts user input)
M:%y!yes!ok!sure    (allows 'y', 'yes', 'ok', or 'sure')
```

- Allow the user to stop the lesson at any time and continue at that point, or close to it, when they resume.

- Allow the user to get "help" at any time. By pressing a certain key, the program would present guidelines on operating instructions.

- Allow the user to enter information in a natural language as opposed to some code. For example, it is better to type in "yes" or "no" rather than "1" or "2".

- The programmer should write programs that are easily maintainable. This can be accomplished by writing well structured and modular programs.

- Use comments in your program to aid understanding.

- Avoid 'tricky' program code.

    EXAMPLE IN PASCAL:

```
Sentence: = 'THE X-RAY MACHINE';
WRITELN (COPY(SENTENCE, POS ('X', SENTENCE, 5));
```

    A better approach might be:

```
SENTENCE: = 'THE X-RAY MACHINE';
START: = POS ('X', SENTENCE);
WORD: = COPY (SENTENCE, START, 5);
WRITELN (WORD);
```

This code prints out the word X-RAY from the sentence THE X-RAY MACHINE.

STAGE 4. EVALUATION

The plan for evaluation presented here can be considered the minimal evaluation which a teacher should include when developing CAI. This basic system of evaluation should proceed from several points of view:

Evaluation of the Authoring Design, Objectives, and Content
Evaluation of the Instructional Quality,
Evaluation of the Technical Quality.

Evaluation should be done by the author and programmer, experts in CAI development, content specialists, and users of the CAI.

Evaluation of the Authoring Design, Objectives, and Content

- DOES YOUR DESIGN INCLUDE

  SUBJECT TITLE
  INSTRUCTIONAL GOALS
  A DESCRIPTION OF THE COURSE IN WHICH THE LESSON WILL BE USED
  A DESCRIPTION OF THE STUDENTS
  OTHER INSTRUCTIONAL MEDIA USED
  STUDENT READING COMPREHENSION LEVELS
  COMPUTER AND LANGUAGE TO BE USED
  PLAN FOR EVALUATION
  WHAT ELSE HAVE YOU INCLUDED IN THE DESIGN?
  HAS THE DESIGN PROVED TO BE USEFUL?

- ARE THE OBJECTIVES WELL DEFINED AND MET?

- IS THE CONTENT IDENTIFIED SO THAT LEARNING STRATEGIES COULD BE READILY DEVELOPED?

- IS THE CONTENT ACCURATE? IS INFORMATION CURRENT? IS THE INFORMATION NOT OVERSIMPLIFIED? ARE GRAPHS AND DISPLAYS ACCURATE?

- DOES THE CONTENT HAVE EDUCATIONAL VALUE? IS IT COMMON SCHOOL SUBJECT MATTER? IS IT USEFUL INSTRUCTIONALLY? IS IT A VIABLE SUBJECT FIELD?

- HAS A SUBJECT MATTER EXPERT REVIEWED THE LESSON TO VERIFY THE ABOVE?

Evaluation of the Instructional Quality

- ARE THE LEARNING STRATEGIES CHOSEN APPROPRIATE FOR STUDENT LEARNING?

- HAVE APPROACHES BEEN USED TO LESSEN STUDENT ANXIETY ABOUT COMPUTER USE?

- WHICH OF THE FOLLOWING LEARNING STRATEGIES HAVE BEEN USED: DRILL AND PRACTICE, DIALOGUE, PROBLEM-SOLVING, AND SIMULATION?
  ARE THEY EFFECTIVE? WHAT OTHER LEARNING STRATEGIES DID YOU USE?

- IS THE PRESENTATION CLEAR AND LOGICAL?

- ARE GRAPHICS, SOUND, AND COLOR USED FOR APPROPRIATE INSTRUCTIONAL REASONS?

- IS THE LESSON MOTIVATIONAL?

  ARE USERS ADDRESSED IN A PERSONAL STYLE?
  DO NARRATIVES USE HUMOR AND CONVERSATIONAL MANNER?
  IS THE OVERALL TENOR WARM, FRIENDLY, AND HELPFUL?
  ARE A VARIETY OF USER RESPONSES POSSIBLE?
  IS REINFORCEMENT POSITIVE?
  IS A USER LEFT WITH THE DESIRE TO EXPLORE THE TOPIC MORE?
  IS THE LESSON ENJOYABLE AND USEFUL?
  HAVE YOU AVOIDED "TELLING" THE STUDENT EVERYTHING?
  HAVE YOU GIVEN THE STUDENT THE OPPORTUNITY TO INVESTIGATE FOR INFORMATION?

- DOES THE LESSON EFFECTIVELY CHALLENGE STUDENT CREATIVITY? IS THE LEARNER ACTIVELY INVOLVED? DOES THE LESSON DEMONSTRATE A CREATIVE MEANS OF USING THE CONTENT?

- IS FEEDBACK ON STUDENT RESPONSES EFFECTIVELY EMPLOYED? IS IT RELEVANT TO RESPONSES, NON-THREATENING, TIMELY? DOES THE FEEDBACK EXPLAIN FURTHER?

- ARE SUPPLEMENTARY READING AND USE OF OTHER MEDIA EFFECTIVE?

- IS THE LESSON UNIQUE OR MORE CONVENTIONAL IN APPROACH? CAN IT BE DUPLICATED THROUGH USUAL TEACHING/LEARNING APPROACHES?

- HAVE EDUCATIONAL EXPERTS REVIEWED THE LESSON TO VERIFY THE ABOVE?

- HAVE STUDENT USERS VERIFIED THE ABOVE?

- WHAT IS YOUR OWN ASSESSMENT OF THE ABOVE?

Evaluation of the Technical Quality

- ARE COMPUTER AND LANGUAGE CAPABILITIES UTILIZED EFFECTIVELY, FOR INSTANCE TO STORE AND RETRIEVE DATA, TO BRANCH, AND TO JUDGE RESPONSES?

- DOES THE COMPUTER PROGRAM EXECUTE IN THE MANNER INTENDED? IS THE PROGRAM FREE OF PROGRAMMING AND OPERATIONAL ERRORS?

- IS THE COMPUTER PROGRAMMING WELL STRUCTURED AND READABLE TO OTHER PROGRAMMERS? CAN REVISIONS BE EASILY ACHIEVED? DO COMMENTS CLARIFY ALL LEVELS OF THE CODE?

- ARE METHODS OF ENTERING USER RESPONSES CONSISTENT THROUGHOUT?

- CAN THE DISPLAYS BE READ WITH EASE?

- HAS THE LESSON BEEN CHECKED FOR PROPER GRAMMAR, SPELLING, PUNCTUATION, AND CONCISE SENTENCE STRUCTURE?

- ARE COLOR, SOUND, AND GRAPHICS CLEARLY PRESENTED AND EFFECTIVE?
- CAN THE USER EASILY INTERACT WITH THE CAI LESSON? CAN YOU MOVE SIMPLY TO THE USE OF A VIDEOTAPE, PRINTER, OR OTHER PERIPHERALS IF THIS IS A PART OF THE LESSON?
- IS THERE CONTINUITY BETWEEN DISPLAYS? DOES ONE DISPLAY MERGE EFFECTIVELY INTO THE NEXT?
- IS PLACEMENT OF MATERIAL WITHIN EACH DISPLAY EFFECTIVE, AND HAS IT BEEN VARIED?
- CAN USERS OPERATE THE LESSON EASILY AND INDEPENDENTLY AND AT THEIR OWN RATES? DOES THE USER HAVE TIME TO PROBLEM-SOLVE AND RESPOND?
- IS THERE SUFFICIENT WRITTEN MATERIAL, COURSEWARE INSTRUCTION, AND HELP FROM THE INSTRUCTOR OR OTHER PERSON TO ORIENT THE STUDENT TO THE USE OF THE COMPUTER AND THE LESSON?
- IS THE LESSON OF A USEFUL LENGTH?
- IS THE LESSON ADAPTABLE TO A VARIETY OF CLASSROOM SETTINGS?
- DOES THE LESSON LOCK THE STUDENT INTO A LINEAR INSTRUCTIONAL SEQUENCE (FOR INSTANCE TEXTUAL PASSAGES), OR CAN THE STUDENT INVESTIGATE CREATIVELY FOR INFORMATION?
- HAS A BACK-UP FUNCTION BEEN PROVIDED SO THAT USERS CAN EASILY RETURN TO DISPLAYS PREVIOUSLY PRESENTED? CAN THE USER EASILY EXIT THE PROGRAM, RETURN TO MENUS, OR MOVE TO ANOTHER SECTION?
- CAN A STUDENT USE THE PROGRAM WITH A MINIMUM OF COMPUTER COMPETENCIES?
- IS A ROUTINE PROVIDED FOR CORRECTING ERRORS WHICH THE STUDENTS MAY MAKE?
- HAS A CAI EXPERT REVIEWED THE ABOVE?
- WHAT IS YOUR OPINION ABOUT THE ABOVE?

The Appendix includes an example of a system of evaluation** which was completed by users of A Lesson on Stress, including students, teachers, consultants, programmers, and interested people in the community. Some students completed a similar evaluation on disk at the computer. The Evaluator's Guide for Microcomputer-Based Instructional Packages, by MicroSIFT of Portland, Oregon, was especially useful in the development of the evaluation form included here, with MicroSIFT's permission.

**See the Appendix for Evaluation for A Lesson on Stress, page 41.

STAGE 5. USE AND DISTRIBUTION

When your CAI courseware is finished (including design, objectives, content, learning strategies, programming, and evaluation), then it is important for you to use it well and distribute it effectively. Here are some ideas which may help.

Put together a complete CAI package for your lesson consisting of:

An abstract of the lesson**
A teacher-student guide***
The completed software
Any other media components such as a videocassette, audio tape, printed handouts, or evaluation forms.

The abstract is intended for any interested people and should include the name of your school, author and programmer names, and the names of any other contributors. Identify:

actual and potential users
instructional prerequisites
required hardware or software
the medium of transfer (for instance, flexible diskettes)
methods of use
instructional objectives
a brief description of the lesson
the plan for evaluation.

The teacher-student guide is intended for those who will actually be using the lesson. Lesson objectives should be included. Help should be given on how to start the computer and how to sign on or access the software, proceed,

**Please see the Appendix for an abstract called CAI Courseware Description of a Lesson on Stress, page 45.

***See the Appendix for a User Guide for Nursing, Math Calculations and Conversions, page 47.

backtrack, correct errors, exit, and the like. As well, the user should be told what the displays will be like and what is expected of him/her; examples of the displays might be included, and hardware and software should be described.

Consider how to distribute your CAI lesson within your school and elsewhere. The degree of interest which the faculty have about CAI will determine to a considerable extent whether others will want to use your lesson and perhaps begin to develop their own. Faculty interest in CAI may depend on your salesmanship, the curiosity you evoke, and the time and energy the faculty have to give. Continuing education at the school about CAI helps to spark interest and upgrade knowledge. Administrative support is of critical importance for the promotion of computer literacy, purchases of hardware and software, a computer laboratory, released time for faculty, the availability of programmers, and more.

Your school may have an existing method for distributing school productions (written, video, film strip, audio, etc.). If so, it is possible that your CAI production may also be listed in the catalog of materials for distribution. If a distributing center is not accessible, then you may want to make contacts which will help you to share your courseware broadly. Issues which need to be considered are ownership, copyrights, costs and payments, and publicizing your work in indices, publications and production lists, journals, and the like.

Best of luck with your courseware. We hope this guide will be helpful, and we solicit your feedback, ideas, and the opportunity to review your CAI lessons when they are complete.

GLOSSARY

GLOSSARY

An Author of CAI as described in this guide is the teacher who designs, develops objectives and content, and creates learning strategies for CAI. The author collaborates with a programmer who is responsible for the programming of the courseware.

A Branching Sequence allows the user to skip to routines in various parts of the computer memory. The CAI user need not proceed sequentially in using the program. In computer terms, a branching sequence is the interruption of a normal line by line (sequential) program execution. A branching sequence breaks a linear sequence.

Computer-Assisted Instruction (CAI) is a mode of teaching in which information is programmed for presentation on the computer screen. The user chooses the content he/she wishes to learn by using the computer keyboard in response to instructions on the television-like screen, thus interacting with the computer. A positive, personalized, and highly individualized learning experience is thereby possible. The programmed material, stored on disks, is called software or courseware.

Computer-Managed Instruction (CMI) involves the user of computers to help the teacher manage her instructional responsibilities. For instance, CMI is useful in selecting test items, in scoring, and in analyzing the results. Course grades can be determined with periodic printout feedback to students. Other records and data can be stored for retrieval in a variety of formats. As well, the use of computers for the evaluation of instructors, courses, and student learning is a kind of CMI.

Courseware is the CAI lesson, usually stored on disks (especially when microcomputers are used). Courseware is programmed material which, when used appropriately, will produce desired displays on the computer screen.

Dialogue Strategy as described in this guide is one of the learning strategies used in the development of CAI. Dialogue is the conversation-like exchange between teacher and student during the courseware presentation, with learning as the objective. At the very heart of the CAI experience is the one-to-one communication of the author with the student through the computer medium. For an example see the section of the guide on learning strategies, pages 10-14.

Drill and Practice Strategy as described in this guide is one of the CAI learning strategies whereby a student practices and repeats a technique at the computer keyboard in a way which will yield improved skills. For instance, multiplication problems. For an example see the section of the guide on learning strategies, pages 15-17.

A Frame as described in this project contains the script, which is the system of writing out what is to be displayed on the screen with additional recommendations for the programmer. The author "frames" or writes down in the script what he wants to appear in the final screen display; "framing" is preliminary to programming. See an example of "framing" (script) on page 10. The use of the "frame" is only one of a variety of ways in which the script may be presented.

Hardware consists of the physical machinery of the computer system, such as the central processing unit, keyboard screen, disk drives, and printer.

Learning Strategies as described in this guide are the instructional methods used to present the content so that students learn most effectively. The content is presented by means of the strategies, and the content extends from the CAI authoring design and objectives.

Linear Sequence enables the user to proceed line by line with the material in the order that it is programmed. Instructions are carried out by the computer one after the other (sequentially) until a non-linear instruction breaks the sequence. Customary reading material, in texts for instance, provides a linear sequence. On the other hand, programmed instruction material is an example of a branching sequence.

A Problem-Solving Strategy as described in this guide is one of the CAI learning strategies. It is the presentation of a problem with the expectation that the student will seek the solution using a known rationale. For example, a student might be asked to solve a physics or mathematical problem which could involve a series of steps. For an example see the section in the guide on learning strategies, pages 18-25.

A Program consists of the programmer's instructions to the computer. The result of the program is the CAI lesson or other output.

To Program is to design an algorithm or step-by-step procedure for solving a problem. This solution is represented in a programming language. Through programming, instructions are presented to the computer which determine what the output of information will be.

The Screen employed in CAI output is a Cathode Ray Tube (CRT) which displays on a TV-type screen. Another term used interchangeably with CRT or screen is video monitor, even though the display is not an actual television presentation.

Simulation Strategy as described in this guide is a CAI learning strategy. It is a reenactment of real-world phenomena so that students learn an action in a highly structured pseudo-situation apart from the real-world activity. For instance, earthbound simulators are used to train astronauts. For an example see the section in the guide on learning strategies, pages 18-25.

Software consists of the information contained in a computer program. CAI software is the lesson material along with the programmed instructions that detail how the lesson is to be presented. The software may be printed out on paper. It is stored on diskettes and tapes so that it may easily be loaded into a computer.

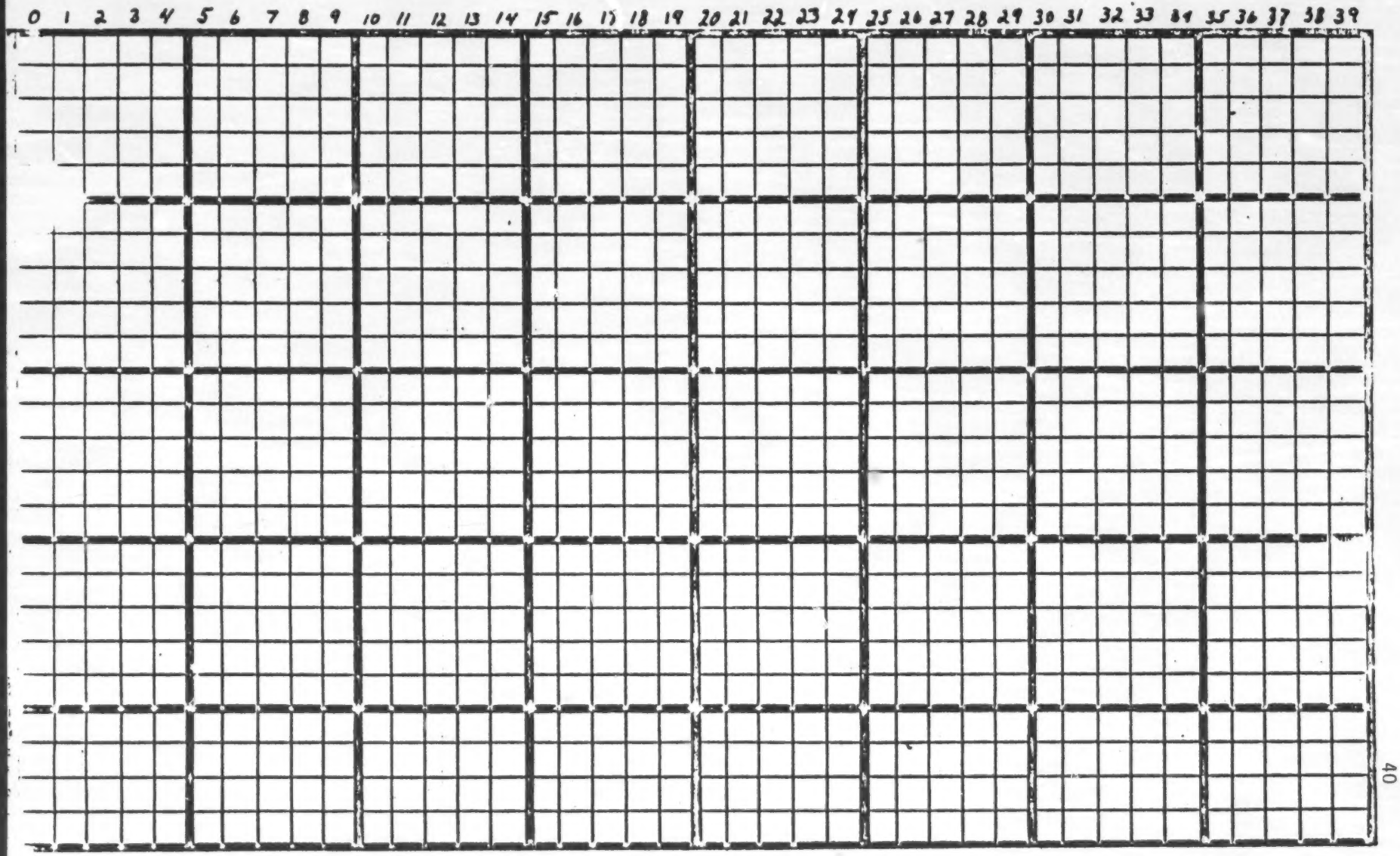
Tutorial instruction is the general instructional mode employed consistently with CAI, whereby students learn and teachers instruct, with the use of computer technology. The Project's staff identified "Tutorial" as the umbrella approach used in CAI, rather than a specific learning strategy.

APPENDIX

APPLE PILOT CODING SHEET

PROGRAM _____ DATE _____

PROGRAMMER _____ PAGE ___ OF ___ PAGES



CHEMEKETA COMMUNITY COLLEGE

EVALUATION FOR A LESSON ON STRESS*

All users of this lesson (except Re-Entry Nursing Students) are asked to complete the following paper evaluation when they have finished the lesson. Re-Entry nursing students are asked to complete an evaluation on disk at the computer. Please return both the paper and disk evaluations to: La Verne Elliott, Computer-Assisted Instruction Nursing Project, Chemeketa Community College, P.O. Box 14007, Salem, Oregon 97309.

Please check the statements below which apply to you, and comment as requested.

___ Student in nursing. What school?_____

___ Student in another field. What field?_____What school?_____

___ Teacher. What school?_____What subject?_____

What is you field of work if not the above?_____

Where are you employed?_____

Write the number of this rating scale which best reflects your judgment about the following statements. Use the space following each item for comments.

1	2	3	4
Strongly Disagree	Disagree	Agree	Strongly Agree

☐ Check this box if this evaluation is based partly on your observation of student use of this package.

If you are unable to respond to a statement, please leave the space blank.

	Write Rating Number Here	Comments
1. The content is accurate.	___	_____
Information current.		_____
Facts correct.		
Information not oversimplified.		_____
Accurate graphs and displays.		
2. The content has educational value.	___	_____
Common school subject matter.		_____
Useful instructionally.		
A viable subject field.		_____
Subject matter useful.		

*The Evaluator's Guide for Microcomputer-Based Instructional Packages by MicroSIFT, Portland, Oregon, has been useful in the development of this evaluation.

Evaluation for a Lesson on Stress
Page 2

	Write Rating Number Here	Comments
3. The objectives of the lesson are well defined (see courseware description).	___	_____
4. The lesson meets the defined objectives.	___	_____
5. The presentation of content is clear and logical. Information is well organized. Definitions and explanations are available when needed. The progression of content is logical. Examples and illustrations are used where possible. Examples are relevant to the point of instruction.	___	_____
6. The level of difficulty is appropriate for the target audience. Responses are appropriate. Readability level is appropriate. Examples and graphics are suitable. The time required is suitable.	___	_____
7. Graphics, sound, and color are used for appropriate instructional reasons.	___	_____
8. Use of the lesson is motivational. Users are addressed in a personal style. Narratives use humor and conversational manner. Overall tenor is warm, friendly, helpful. A variety of user responses are possible. Reinforcement is positive. A user is left with a desire to explore the topic more. The lesson is fun. The lesson is useful.	___	_____

Evaluation for a Lesson on Stress
Page 3

	Write Rating Number Here	Comments
9. The lesson effectively challenges student creativity. The learner is actively involved. The lesson demonstrates a creative means of using the content. The lesson suggests further exploration.	___	_____
10. Feedback on student responses is effectively employed. Is relevant to responses. Is non-threatening. Is timely. Explains further.	___	_____
11. The lesson is unique. Cannot be duplicated through usual teaching/learning approaches.	___	_____
12. The lesson helps to prepare Re-Entry nursing students for clinical practice.	___	_____
13. The lesson helps users to cope with their own stress.	___	_____
14. The lesson assists users to help patients with stress.	___	_____
15. The lesson takes advantage of computer capabilities.	___	_____

16. Describe the major strengths of the lesson:

Yes or No

17. _____ I would use or recommend use of this lesson with little or no change. Please note suggestions for effective use.

18. _____ I would use or recommend use of this lesson only if certain changes were made. Please note the major weaknesses and the changes needed.

19. _____ I would not use or recommend this lesson. Please note the major weaknesses, changes needed, and why you would not use the lesson.

Thank you. We appreciate your help and hope that you found the lesson useful.

9/81

CHEMEKETA COMMUNITY COLLEGE

COMPUTER-ASSISTEND INSTRUCTION
COURSEWARE DESCRIPTION

A Lesson on Stress *
for Re-Entry Nurses and Others

Date of First Version:	September, 1981
Author:	La Verne Elliott, RN, MN, MPH Nursing Instructor, Coordinator for Specialty Courses for Nurses, Director of Nursing CAI Project
Programmer:	Werner Brandt, BA Assistant Director of College Wide Computer-Assisted Instructional Program
	Programmer Trainees: Colleen Follas Katy Cavenport Gene Halverson
Graphics:	Robert Shaw, Ed.D. Director of Visual Communications
Evaluator:	Melissa Cranor, RN Re-Entry Program Graduate
Designed for:	Re-Entry Nurses in a Community College Program who have not been practicing recently or who wish to update their nursing abilities.
Instructional Prerequisites:	Previous Licensed Practical Nurse or Registered Nurse licensure. However, the lesson can also be useful to other nurses or non-nurses.
Required Hardware:	Apple II Plus/48K 1 Disk Drive 1 Monitor (Color preferred or B/W)
Required Software:	No additional software needed.
Medium of Transfer:	5 - 5" flexible diskettes. 1. Main Menu - Information: 8-10 min. 2. Stress Self-Assessment: 15-20 min. 3. Anxiety, Stress, and the General Adaptation Syndrome: 15-20 min. 4. Stressors: 10-15 min. 5. Coping with Stress: 20-25 min.

* Produced through a grant from the Oregon State Department of Education. The Evaluator's Guide for Microcomputer-Based Instructional Packages by MicroSIFT, Portland, Oregon, has been useful in the development of this courseware description and in the evaluation of the Stress Lesson.

Computer-Assisted Instruction - Courseware Description
Page 2

Methods of Use:

The entire lesson can be individually assigned and followed by group discussion (especially for Re-Entry Nurses). Separate parts of the lesson can be assigned. The lesson, or parts, can be presented with small student groups.

Instructional Objectives:

After completing this computer-assisted instruction lesson, Re-Entry nursing students and others will be able to:

1. Identify their own level of stress through self-assessment.
2. Define anxiety, stress, and the General Adaptation Syndrome, and understand the psychophysiological stress response.
3. Define stressor and identify major psychosocial, physical, and chemical stressors, as well as specific stressors experienced by Re-Entry Nurses and hospital patients.
4. Identify a strategy for coping with their own stress and for helping stressed patients.

Abstract:

The Stress Lesson is designed to help Re-Entry Nurses and others assess and cope with their own stress and the stress of hospitalized patients. Users take a stress quiz and the Holmes-Rahe Life Change Index to assess their stress levels. Through interaction with the computer, they learn about the nature of stress, stressors, and an intervention for coping with stress. Graphics, color, and sound enhance the presentation. The lesson is in five parts - users control the rate, sequence, and amount of the content provided. They may also elect to review parts, if desired.

Evaluation:

Re-Entry Nurses are asked to evaluate the lesson on disk and return the evaluation to the author.* Other users are asked to complete an evaluation on paper and return it to the author. Paper evaluation will be supplied to the user by the author.

* A sixth disk will be supplied for evaluation when Re-Entry Nurses are using the lesson.

CHEMEKETA COMMUNITY COLLEGE
4000 Lancaster Dr. N.E.
P.O. Box 14007
Salem, Oregon 97309

User Guide for Nursing Math Calculations and Conversions

If you have not used a computer before, be patient and seek a new experience - will be experiencing immediate feedback.

1. A brief orientation to the computer will be needed before attempting this program, (i.e., keyboard, on/off switch, loading diskettes). The RETURN key must be pushed after all interactions with the computer for the program to progress.

2. The program operates off a main menu, including the three methods of measurement and conversion, then subdivides as follows:

	Main Menu	Sub-Menu
On One Diskette	1. Metric	1. Length 2. Volume 3. Weight 0. End Lesson
	2. Household	1. Length 2. Volume 3. Weight 0. End Lesson
	3. Apothecary	1. Volume 2. Weight 0. End Lesson
On One Diskette	4. Conversions	1. Length {Household ⇄ Metric 2. Volume {Metric ⟹ Household; Metric ⟹ Apothecary; Apothecary ⇄ Household 3. Weight {Metric ⟹ Household; Metric ⟹ Apothecary

A menu is a listing of topics for selection.

End lesson returns user to main menu.

See the following objectives for specific material in each sub-menu.

Upon completion of the metric measures unit:

1) list the basic units of liquid measures of the metric system (L, ml, cc).

2) list the basic units of weight measures of the metric system (Kg, Gm, mg, mcg).

3) convert between milligrams and grams.

4) convert between micrograms and milligrams.

5) convert between milliliters and liters.

6) convert between cc's and milliliters.

7) convert between grams and micrograms.

Upon completion of apothecary measures unit:

1) list the basic units for fluid volume in the apothecary system (m, f℥, f℥).

2) list the basic units for weight in the apothecary system (gr, ℥, ℥).

3) convert between drams and minims.

4) convert between ounces and drams.

5) convert between ounces and minims.

Upon completion of the household measures unit:

1) list commonly-used units of household measures in drug administration (tsp, tbsp, oz, gtt, cup).

2) convert between drops and teaspoonfuls.

3) convert between teaspoonfuls and tablespoonfuls.

4) convert between tablespoons and ounces.

5) convert between ounces and cups.

6) convert between ounces and teaspoonfuls.

7) convert between drops and tablespoons.

Upon completion of the conversion between apothecary and household measures unit:

1) convert between drops and minims.

2) convert between minims and teaspoonfuls.

3) convert between drams and tablespoonfuls.

4) convert between drams and ounces.

Upon completion of the conversion between metric and household measures:

1) convert between pounds and kilograms.

2) convert between drops and cc's.

3) convert between cc's and ounces.

4) convert between cc's and teaspoonfuls.

5) convert between cc's and tablespoonfuls.

Upon completion of the conversion between metric and apothecary unit:

1) convert between cc's and minims.

2) convert between cc's and drams.

3) convert between grains and grams.

4) convert between grains and milligrams.

5) convert between cc's and ounces.

Upon completion of the conversion between metric, household, and apothecary measures unit:

1) convert between the metric and household measures.

2) convert between the metric and apothecary measures.

3) convert between the household and apothecary measures.

The user will:

1. select a main menu topic.

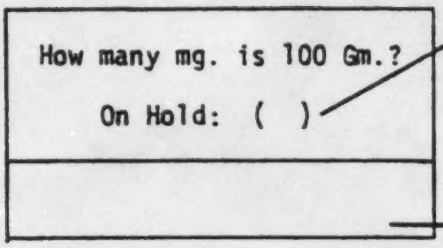
2. select a sub-menu topic.

3. select or reject main concept explanation.

4. select or reject sample problem.

5. select as many problems as desired.

5. (con't.)



Hold allows user to work part of problem and retain partial answer or to recalculate and check answer before pushing / a / to accept answer. Each time a calculation is done, it replaces the previous value in Hold.

Empty work space for user.

All measures are abbreviated in the problem statement. If unsure of abbreviation, check with specific sub-menu charts. Be sure and read problem carefully (c = cup, cc = cubic centimeter, in = inch, etc.)

Each unit of measure has a range that is on a random generator; therefore, the user has no control over the types of order of problems that present in sub-menu. The ranges may not be realistic at times, but the users' ability to convert is the aim of the program. After three incorrect attempts, the computer will display the correct answer and method of calculation.

6. Special keys may be utilized once in the problems section.

   Keys:

   C = display a chart of all conversions for that unit and a hint on how to approach the problem.

   ? = displays instructions for the math characters:

   + = add, - = subtract, * = multiply, / = divide

   A = must be typed for computer to recognize this answer as users' final answer.

7. reject further problems which return to sub-menu or displays score for that unit.

8. select additional topics off menu or quit.

9. spend as much time with computer as desired.

At the end of each sub-menu, the computer will calculate the users' score for that unit (i.e., 9/10 = 90% correct) based on correct first-try answers.

Scores are not retained on the computer for instructor use. If user desires to keep a record of individual score, this must be kept by user.

Enjoy the Experience!

Please fill out a written evaluation form. Thank you.

12/2/81 JI/kc

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